Washington Center for Semiconductor Research, Development and Innovation

Growing Washington's Silicon Forest

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Washington Center for Semiconductor Research, Development and Innovation

Growing Washington's Silicon Forest

Summary

Southwest Washington is home to Washington's Silicon Forest, a nationally recognized concentration of semiconductor and electronics manufacturing industries. For the industry to grow and evolve in the face of increasing global competition, the region must develop an indigenous source of innovation, research and product development.

The Washington Center for Semiconductor Research, Development and Innovation represents the 'triple helix' overlay of communications and interactions between industry, university, and government. A primary goal is to develop at Washington State University – Vancouver world class research capabilities in scientific disciplines that support the semiconducting materials and electronic device competencies of the region's businesses. Other goals are to develop shared laboratory facilities to incubate private sector innovations and to advance the skills of the technology manufacturing workforce.

The Center is the result of collaboration of economic development, workforce development, and education entities and private industry. The partners have worked closely over the last six years to support the growth of the technology sector in Southwest Washington. The principle partners in this proposal are the Columbia River Economic Development Council, Southwest Washington Workforce Development Council and Clark County High Tech Council. Collaborators are Washington State University – Vancouver (WSUV), Clark College and the Washington Technology Center.

The immediate geographic sphere of influence of the Center is Southwest Washington and the Vancouver/ Portland Metropolitan Area. It is expected that the Center will have relevance to semiconductor materials and microdevice companies throughout Washington and Oregon.

The following are the actions necessary to create the Center:

1) Accelerate the previously scheduled design and construction of the WSUV Applied Technology Classroom Building by funding and executing a design/ build contract in 2007.

2) Fund the construction and tooling of a branch of the Washington Technology Center Microfabrication Lab as an integral component of the WSU-V Applied Technology Classroom Building.

3) Secure start-up and high demand funding to establish the electrical engineering degree program at WSUV in 2009.

4) Secure funding to recruit high impact research faculty and research teams in specific disciplines with relevance to the semiconductor materials and device sector.

5) Secure workforce development funding for advance skill training of semiconductor materials and microdevice fabrication operators and technicians.

6) Accelerate the production of engineering and science degrees at WSU –V through collaboration/ extension with the University of Washington Engineering Department.

Total investment to implement the Center is $50 million in capital and $3.3 million in operating expenditures. At a minimum the proposal will leverage an additional $2 million in private contributions.

The expected outcomes of the successful development of the Center are:

1) Increased production of local graduates with Bachelor's and advanced degrees in the math and sciences available for employment with local technology firms.

2) Private industry access to research facilities and equipment to support research and development activities. This activity is expected to result in new products, increased productivity of existing firms and new company formations.

3) Increased opportunities for private industry/ university collaboration that will result increased innovation and product development.

4) Advancement of the skills, productivity and wages of the technology manufacturing workforce.

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> The scientific enterprise in the United States represents one of our country's greatest strengths. It is an enterprise characterized by intricate interrelationships between governments, industry, and universities. It draws strength from the American eagerness to innovate, our entrepreneurial spirit, and a research and technology base of considerable depth and strength. However, this enterprise cannot be expected to remain strong without attention. We must ensure that its components are functioning well, and that the interactions between the various players in it are productive.[*]

Introduction

Southwest Washington is home to Washington's Silicon Forest, a concentration of high technology industries in the Vancouver/ Portland metropolitan area. The Washington semiconductor industry emerged as a significant economic cluster during the 1990s. The region joined San Jose, Austin, and Phoenix as national concentrations of technology based industries.

Washington's semiconductor sector is a fully integrated cluster of micro-device manufacturers, intellectual property companies, semiconductor materials manufacturers, equipment suppliers and support services. In 2004, Washington companies in the micro-device and materials portions of the sector (NAICS 33313) employed over 2,500, paying in excess of $36 million in wages and booked over $801 million in sales[†]. These firms paid the state over $3.8 million in business and occupation taxes (B & O) and $8.2 million in property taxes on $675 million in assessed valuation. Using standard multipliers, the semiconductor sector generates over $1.2 billion in direct and indirect revenues and 5,250 jobs within the state of Washington. This is exclusive of the hundreds of firms and employees in supporting and related industries.

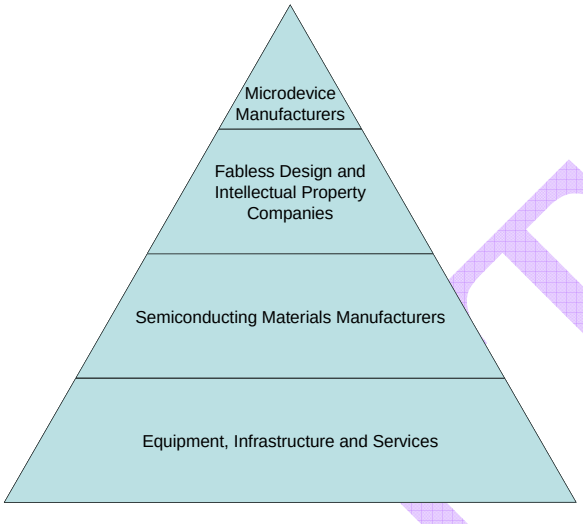
Washington State Semiconductor Employment and Sales

	# Firms	Gross Sales 2004	Covered Employment	Covered Wages	Assessed Valuation I (2004)	Property Taxes Due (2005)
Clark County	7	724,490,363	2,169	$28,419,085	$641,806,050	$7,836,110
Rest of State	12	77,095,677	395	$7,960,333	$33,223,942	$431,911
Total	19	801,586,040	2,564	$36,379,418	$675,029,992	$8,268,022

[*] Unlocking Our Future; Toward a New National Science Policy; A Report to Congress by the House Committee on Science; September 24, 1998

[†] Washington Department of Revenue and Washington Employment Security Department, November 2005.

Core competencies of Washington's semiconductor cluster are the continuum of technologies from the manufacture of semiconducting materials to microdevice design through final device manufacturing and assembly.



Washington's Semiconductor Cluster

SW Washington's technology cluster is unique in the nation in that it did not evolve in proximity or collaboration with a major research university. Absent a university, regional technology stalwarts such as Tektronix and Intel served as surrogate centers of innovation, workforce training and sources of entrepreneurial start-ups. While this model of economic development has been successful for SW Washington, longer term, there are challenges.

Challenges Facing Washington's Semiconductor and Microelectronics Industry

There are technology and competitive shifts in the cluster that impact the health and growth of the technology industry in SW Washington. The Center will support basic and applied research to assist the cluster to address the following issues.

What is the Future of Silicon?

Current semiconductor technology is largely based on silicon substrates. As computing technology evolves, new and advanced semiconducting materials such as gallium arsenide (GaAs), silicon on insulator (SOI), strained silicon and other currently exotic materials will supplant silicon as the preferred semiconducting substrate. The viability of the cluster is at risk if does not innovate and evolve to lead or adopt these and other technological advances.[‡]

[‡] See Thinking Small; Nanotechnology and the Future of Silicon; http://www.intel.com/technology/silicon/si10031.htm#sec2

Manufacturing Technology Advances

Semiconductor manufacturing is a mature industry and driven by the same forces as other commodity sectors. These include advances in manufacturing technology, reduced profit margins and demands for increased productivity. The current manufacturing standard of 200-mm (8- inch) wafer fabs is being replaced by 300-mm (12- inch) facilities with an associated productivity increase of 2.5. Intel Corp. is considering a plan to build a development fab in Oregon, which could possibly become the world's first 450-mm (16-inch) facility.[§] If Washington's semiconductor industry does not adopt advanced manufacturing processes, its global competitiveness will be compromised and long term viability challenged. Advances in manufacturing technology also require technology adoption and skills upgrading of the manufacturing workforce. The Center will support the adoption of advanced manufacturing technologies.

Research and Development Investment is Global

Over 60% of global investment in research and development is occurring outside the United States.[**] To recruit expansion or new investment in private research and development SW Washington must have an indigenous talent base and source of original innovation. The cluster is currently dominated by branch plant manufacturing and regional headquarters. Research and development investment, public and private, is critical to the evolution of the regional technology industry. The Center will allow existing businesses to supplement their R and D programs, allow for the incubation of technology 'spin-outs', and serve as the nucleus to attract global R and D investment.

Advancing Skills of the Skilled Workforce

Concurrent with the adoption of advanced manufacturing systems is industry's demand for a higher skilled manufacturing workforce. As manufacturing 'leans' out, firms are requiring higher skills across the organization. For example, a local materials firm is demanding that new entry level manufacturing hires have an associate's (AA) degree as the company transitions to 300-mm wafer manufacturing technology. This need for higher skilled employees is being seen across the technology sector. The Center will have workforce training support as a key foundation.

Research and Innovation Support

The absence of a robust research university limits emerging and small firms' ability to partner on research initiatives or draw on university based talent to support growth. To overcome this gap, a number of SW Washington firms rely on distant labs and collaborators in Seattle, the Tri-Cities and Oregon to conduct research on new products and manufacturing methods. This arrangement is inefficient does not support the long term need of the region. The Center will serve to incubate new technology start-ups.

Production of Talent

A major challenge facing the cluster is the lack of local graduates in the math, science and high impact disciplines. The foundation for an innovation economy is human talent.

[§] Mark LaPedus, Intel mulls 450-mm fab in Oregon; EE Times; November 30, 2005

[**] Gene DePrez; IBM Business Consulting Services; IEDC Leadership Summit; January 2006

Competition for this scarce resource is fierce. Local technology companies desire the ability to recruit interns and full time employees from the region. They believe enhanced local production of Bachelors and advanced degrees at Washington State University – Vancouver will heighten their ability to recruit and retain talent. The Center addresses this key deficiency in SW Washington.

Supporting Innovation in Washington's Semiconductor and Microelectronics Industry

Southwest Washington's previous calls for support of the cluster have resulted in incremental successes that include:

- Establishment of the Science and Engineering Institute at Washington State University- Vancouver that addresses 'pipeline' issues within the regional school districts and community colleges for math and science and high impact degrees.
- Support and passage of three pieces of legislation supporting research, development and reinvestment in the semiconductor materials and device sector.
- Funding and authority to admit freshman and sophomores at WSU-V to support production of math, science and high impact degrees.

Washington Center for Semiconductor Research, Development and Innovation

The following describes an integrated strategy to support innovation, and transformational long term economic growth of Washington's semiconductor materials and electronic device sector.

Organizing Concepts

The development of the Washington Center for Semiconductor Research, Development and Innovation is built on the foundation concepts:

1) For the technology sector of SW Washington to grow and evolve it must develop an indigenous source of innovation embodied in a world class research institution at Washington State University – Vancouver.

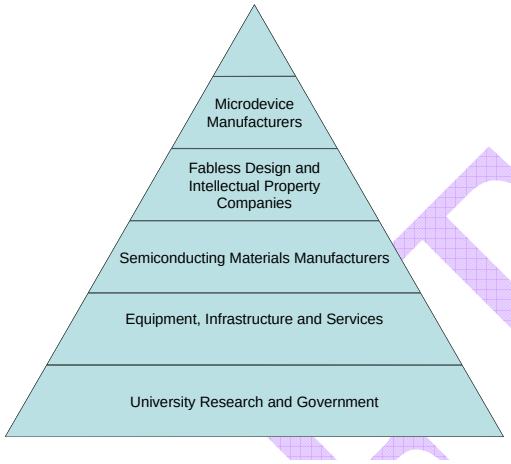
2) Innovation requires a 'triple helix' overlay of communications and interactions between the three institutional spheres (three helices) of industry, university, and government.[††]

3) Future innovation takes place at the interface of scientific disciplines and nodes in the product cycle.

4) The core competencies of the regional technology sector are semiconducting materials, device design and manufacturing. Innovation in the cluster will occur between materials sciences and electrical engineering and design.

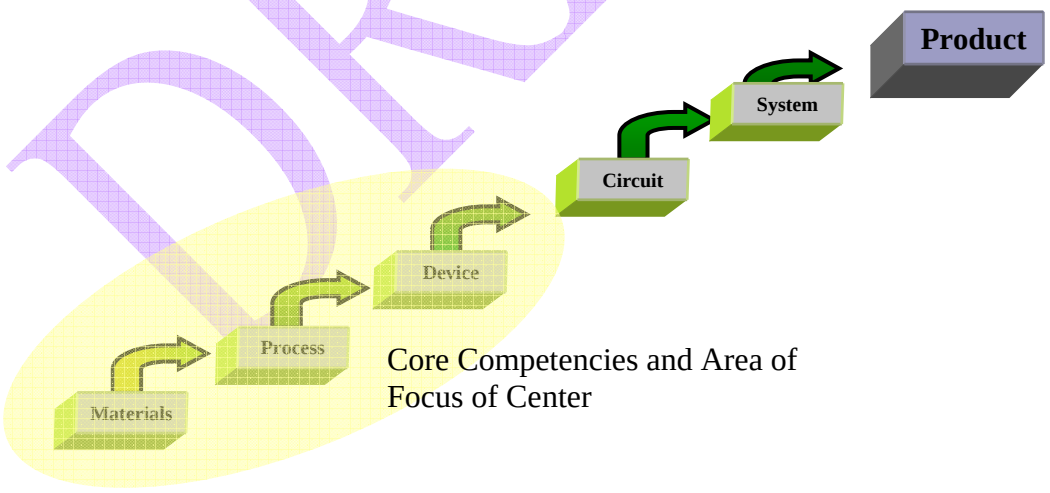
[††] Michael D. Mehta (2002); Nanoscience and Nanotechnology: Assessing the Nature of Innovation in These Fields; Bulletin of Science, Technology & Society, Vol. 22, No. 4, August 2002, 269-273.

5) Creation of an innovation infrastructure is the best mechanism to support the evolution and future growth of the technology and semiconductor industry cluster in the region and state.



A New Model for the Semiconductor Cluster

The evolution of technology products is described in the graphic below. Innovation takes place at and between the nodes supported by public and private research and development capabilities.



Progression of Technology from Materials to Product

Goals and Objectives of the Center

With proper collaboration, funding and execution the goals of the Washington Center for Semiconductor Research, Development and Innovation can be achieved. The goals are to:

1) Develop deep collaboration between a robust (local) research university and the semiconductor/ microdevice industry to support innovation.
2) Develop core research competencies to develop innovative and evolutionary technologies.
3) Expand the production of engineering and manufacturing talent to support the growth of the sector.

Objectives

There are three fundamental objectives and initiatives to create the Washington Center for Semiconductor Research, Development and Innovation. Several have been started and need to expand and accelerate. Several are new and critical to the overall strategy.

1) Develop the physical infrastructure to support innovation and workforce training

   Washington State University - Vancouver Applied Technology Classroom Building

   - Accelerate the design and construction of the WSU-V Applied Technology Classroom Building by funding and executing a design/ build contract in 2007.

   Washington Technology Center - Vancouver Microfabrication Lab

   - Fund, construct and tool a branch of the WTC Microfabrication Lab as an integral component of the Applied Technology Classroom Building. The Lab will be used as a center of joint research and development for the semiconductor and microelectronics industry. It will also serve as research facilities for university faculty and students.

2) Develop the workforce training and talent production capabilities to support innovation and growth of the semiconductor cluster
   - Secure start-up and high demand/ high impact funding to establish the electrical engineering degree program at WSUV.
   - Secure workforce development funding for advanced skill training of fabrication operators and technicians.
   - Provide cluster specific recruitment, screening and work readiness assessment through in-kind support and state funding.

3) Expand the innovation and research capacity of Washington State by taking the initial steps to build WSU-V as a world class research institution
   - Secure funding to recruit high impact research faculty and research teams in specific disciplines with relevance to the semiconductor materials and device sector
   - Expand post graduate and PhD level instruction at the WSU-V campus in disciplines with relevance to the semiconductor materials and device sector
   - Build Collaboration between WSU and UW Engineering programs to build world-class engineering programs in SW Washington.

Influence Area

The Center is expected to have its greatest impact on the businesses and economy of Southwest Washington and the greater Vancouver/ Portland metropolitan area. However, the Center will be of benefit to semiconductor materials and microdevice industry throughout the State. As the capabilities of the Center grow and collaborative relationships develop with other research centers, it is expected to have impact to the entire sector in the Pacific Northwest.

Technology Advances

The Center is expected to support the advances and adoption of several technology advances in the semiconductor materials and microdevice sector.

- Innovation and migration of the cluster to advanced semiconducting substrates such as SOI, strained silicon, epitaxial wafers and others. A special focus will be the interface between materials and device architectures such as LCDs, photonics and display devices, telecommunications microchips and analog technologies.
- Adoption and integration of advanced manufacturing processes in wafer and microdevice manufacturing. The focus will be on increases in productivity, manufacturing yield and quality.
- Commercialization of new technologies and incubation of start-up firms based upon technologies from the Center and regional research and development activities.

Expected Outcomes

It is difficult to quantify the specific outcomes from the operations of the center. The successful operation of the center will result in:

- Advances in semiconductor materials and device technology.
- Research support for regional semiconducting businesses
- An increase in the number of engineering graduates available for employment in the semiconductor cluster
- Successful start-up of new semiconductor related businesses
- Increases in productivity of businesses in the cluster

- Skills upgrading of the incumbent workforce.

Washington Center for Semiconductor Research, Development and Innovation
Consolidated Budget

Initiative		Total	Subtotal	Capital Budget	Operating Budget	WTC Capital Budget	Work Force Training Budget	Federal Appropriation	Private Industry
Infrastructure		**51,230,000**							
Design Build of WSU-V Applied Technology Building			39,070,000	39,070,000					
Washington Technology Center Vancouver Microfabrication Lab			12,160,000						
	Preliminary Design		160,000					160,000	
	Design and construction		8,000,000			8,000,000			
	Basic equipment		2,000,000			1,000,000			1,000,000
	Two year start-up and operations		2,000,000			2,000,000			
Talent and Workforce Initiatives		**3,307,500**							
WSUV EE Start-up Costs			2,500,000		2,500,000				
High demand/ high impact funding			347,500		347,500				
Advanced skill training			400,000				300,000		100,000
Cluster specific recruitment			60,000				60,000		
Innovation and Research Capacity		-							
High impact research faculty and research			Included Above						
Post graduate and PhD level instruction			Included Above						
WSU and UW Engineering programs			TBD						
Total		**$ 54,537,500**		**$ 39,070,000**	**$ 2,847,500**	**$ 11,000,000**	**$ 360,000**	**$ 160,000**	**$ 1,100,000**